ADVANCED INDUSTRIAL RESOURCES, INC.

BOILER MACT TEST REPORT
NO. 11 BOILER
AT
VERSO ESCANABA LLC
ESCANABA, MICHIGAN
PROJECT ID: KR-9649

RECEIVED
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AIR QUALITY DIVISION

PREPARED FOR:

VERSO

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ESCANABA, MICHIGAN 49829

PREPARED BY:
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Test Date:
JUNE 12, 2017

ADVANCED INDUSTRIAL RESOURCES, INC.

REPORT CERTIFICATION SHEET

Having conducted the Technical Review of this report, I hereby certify the data, information, results, and calculations in this report to be accurate and true according to the methods and procedures used.

August 3, 2017

Derek Stephens
Technical Director
Advanced Industrial Resources

Date

Having written and prepared this report, I hereby certify that the data, information and results in this report to be correct and all inclusive of the necessary information required for a complete third-party review of the testing event.

August 3, 2017

Steven Haigh
Report Preparation Director
Advanced Industrial Resources

Date

Having supervised all aspects of the field testing, I hereby certify the equipment preparation, field sample collection procedures, and all equipment calibrations were conducted in accordance to the applicable methodologies.

June 23, 2017

Dan Kirk
Field Project Supervisor
Advanced Industrial Resources

Date

1.0 INTRODUCTION

1.1 SUMMARY OF TEST PROGRAM

Verso Escanaba LLC (VE) operates an integrated pulp and paper mill in Escanaba, Michigan. The facility is operated under the Michigan Department of Environmental Quality (MDEQ) issued Renewable Operating Permit (ROP) Number MI-ROP-A0884-2016. The No. 11 Boiler is also subject to the operational and emission limits established under 40 CFR 63 Subpart DDDDD – *NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters.*

This document represents the test report for establishing compliance with the applicable mercury emission limits set-forth in the referenced NESHAP guidance. It is noted that NESHAP compliance testing was successfully conducted initially in 2015 and the 2nd annual NESHAP testing was again conducted in 2016. Emissions measured during these performance tests were determined to be below 75% of the respective emissions limits and therefore the facility should be subject to reducing its NESHAP performance testing frequency to every 3rd year. However, due to quality assurance deficiencies encountered with the Method 30B mercury sampling conducted in 2016, MDEQ required the facility conduct additional mercury testing to further demonstrate mercury emission compliance on the No. 11 Boiler. Further, because this test was considered a 'retest', no operational limits were set during this testing since only mercury was quantified.

Testing was conducted on the No. 11 Boiler exhaust duct and stack to quantify the emissions of mercury. The field sampling portion of the test program was conducted on June 12, 2017, in accordance with the site-specific Test Plan submitted to the MDEQ. All test methods and procedures were performed by Advanced Industrial Resources, Inc. (*AIR*) in accordance with approved USEPA Methods (i.e., 40 CFR 60 Appendix A Methods 1, 2, 3a, 4 and 30B).

1.2 KEY PERSONNEL

The key personnel who coordinated the test program and their telephone numbers are:

Adam Becker, Verso Escanaba LLC	906-233-2929
Derek Stephens, *QSTI I-IV*, Advanced Industrial Resources	404-843-2100
Scott Wilson, Advanced Industrial Resources	800-224-5007

2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

2.1 PROCESS & CONTROL EQUIPMENT DESCRIPTION

Escanaba Paper Company operates a pulp and paper mill in Escanaba, Michigan. Processes at the facility include the No. 11 Boiler.

The No. 11 Boiler (EU11B68), installed 1981, modified 1986, is an ABB Combustion Engineering combination fuel boiler rated for 750,000 pounds of steam per hour (approximately 1040 million BTU per hour heat input) that provides steam for mill processes and steam turbine-generators for producing electricity. The No. 11 Boiler burns natural gas and solid fuels, which include pulverized coal, wood residue, wastewater treatment plant residuals, Tire-Derived Fuel (TDF), and non-hazardous secondary material (NHSM) engineered fuel pellets. Emissions from the No. 11 Boiler are controlled by an over-fired air system (OAF), multi-clone, and electrostatic precipitator. Opacity is monitored by a COMS which meets the design, installation, performance and certification requirements of Performance Specification 1 under Appendix B of 40 CFR 60 and the quality assurance requirements of Procedure 2 under Appendix F to 40 CFR 60. The COMS also meets the requirements of 63.7525. The boiler utilizes an oxygen trim system to maintain optimum air to fuel ratios. For purposes of Boiler MACT compliance, the No. 11 Boiler is in the *hybrid suspension/grate burners designed to burn wet biomass/bio-based solid* subcategory. The Table 2-1 summarizes the applicable Boiler MACT emissions limits and operating parameters associated with No. 11 Boiler.

Table 2-1
Boiler No. 11 Summary of Applicable Emissions Limits and Operating Parameter

Pollutant	Emissions Limit	Control Device	Operating Parameter
Filterable PM	0.44 lb/MMBtu heat input	Multi-Cyclone, Dry ESP	Opacity
CO	3,500 ppmvd @ 3% O_2 [(a),(b)]	N/A	Oxygen Trim System Set Point

Pollutant	Emissions Limit	Control Device	Operating Parameter
Hg	5.7E-06 lb/MMBtu heat input	Multi-Cyclone, Dry ESP	Hg input loading to boiler
HCl	2.2E-02 lb/MMBtu heat input	N/A	HCl input loading to boiler
All	N/A	N/A	Operating Load (as steam flow)

(a) Emissions limits for filterable PM and CO are for boilers under the subcategory of ***hybrid suspension/grate burners designed to burn wet biomass/bio-based solids.***
(b) Parts per million by volume, dry basis, corrected to 3% oxygen concentration.

The applicable operating limits and compliance methodology for each parameter are summarized below in Table 2-2. Operating limits have been set through Initial Performance Testing and may be modified based on subsequent testing. Operational data collected during the performance test runs is included in Appendix G.

Table 2-2
Boiler No. 11 Summary of Operating Limits

Parameter	Compliance Methodology[a]	Operating Limit[b]
Opacity	Conduct initial and annual performance testing for filterable PM. Maintain opacity to less than or equal to 10% (daily block average)	≤10%
Oxygen Content[b]	Conduct initial and annual performance testing for CO. Operate the oxygen trim system set no lower than the lowest hourly average oxygen concentration measured during the most recent CO performance test.	2%
Operating Load	Conduct initial and annual performance testing for filterable PM, CO, Hg, and HCl. Maintain the operating load such that the 30-day rolling average steam flow rate does not exceed 110% of the highest hourly average operating load recorded during the most recent performance test.	698 KPPH (max. avg. steam flow); 767 KPPH (110% of max. avg. steam flow)
HCl Input Loading	Monitor HCl monthly pollutant loading to the boiler by monitoring each fuel type's heat input to the boiler and multiplying that by the pollutant concentration and maintain HCl loading at or below the level established during the performance test with maximum HCl loading.	3.16E-02 lbs HCl/mmBTU heat input
Hg Input Loading	Monitor Hg monthly pollutant loading to the boiler by monitoring each fuel type's heat input to the boiler and multiplying that by the pollutant concentration and maintain Hg loading at or below the level established during the performance test with maximum HCl loading.	2.37E-06 lbs Hg/mmBTU heat input

(a) Per Boiler MACT, if your performance tests for a given pollutant for at least two (2) consecutive years show that your emissions are at or below 75% of the emissions limit for the pollutant, and if there are no changes in the operation of the individual boiler or air pollution control equipment that could increase emissions, performance test frequency for the pollutant may be decreased to once every three (3) years.
(b) Boiler MACT does not specify specific oxygen trim system range requirements. EPC has assigned the minimum set point based on performance testing.

(c) No operating parameters were set during this test event since the test was considered a 'retest' and only mercury was quantified. Steam operating load and oxygen content values presented in the table were established during the 2nd annual Performance Test conducted in 2016.

2.2 SAMPLING LOCATION

The sampling location on the No. 11 Boiler exhaust is located at greater than 8.0 equivalent diameters downstream from the nearest upstream flow disturbance and at least 2.0 equivalent diameters upstream from the stack exhaust. The exhaust stack has a circular cross-section with an internal diameter of 168.0 inches. The stack has four sampling ports oriented on a 90 degree horizontal plane perpendicular to the exhaust flow direction. A schematic diagram of the sampling location is presented in Appendix D. Twelve (12) sampling points (three points per port) were used for USEPA Methods 2, 3A, 4 and 30B sampling, in accordance with USEPA Method 1 requirements.

3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

3.1 OBJECTIVES

The purpose of the testing was to establish compliance with the applicable emissions limits set-forth in the referenced NESHAP as well as to establish source and control device operational limits, as applicable, on the No. 11 Boiler. Testing was conducted under a single operating condition while firing coal, bark, and gas. This operating condition was intended to demonstrate compliance with the Boiler MACT limits for Hg while burning the maximum pollutant loading fuel mixture. No operating limits were set during this testing since the test was considered a 'retest' and PM, CO, and HCl emissions were not required to be quantified.

3.2 FIELD TEST CHANGES, PROBLEMS, OR ITEMS OF NOTE

The testing was conducted in accordance with the Site-Specific Test Protocol submitted to the MDEQ. No problems were encountered during testing that required deviation from the planned test protocol.

3.3 PRESENTATION OF TEST RESULTS

Emission rates and concentrations are summarized and compared to NESHAP BMACT limits in Table 3-1. Complete emissions data are presented in Appendix A and Reduced and tabulated data from the field-testing is included in Appendix B. The calculations and nomenclature used to reduce the data are presented in Appendix C. Actual raw field data sheets are presented in Appendix D. Laboratory reports and custody records are presented in Appendix E.

TABLE 3-1: Results Summary - BMACT (63 DDDDD) Emission Standards

Source	Operating Condition	Pollutant	Average Measured	Allowable	Units	% of Allowable
No. 11 Power Boiler	Coal, Bark, & Natural gas	Hg	8.4E-07	5.7E-06	lb / MMBtu	**15%**

3.4 PROCESS OPERATION DATA

All essential process and control device monitoring equipment was operating and data was being recorded throughout the test periods. Data collected is presented in Appendix G and includes heat input rates per fuel type, applicable CEMS and COMS data, control device operating parameters and steam production rates.

4.0 SAMPLING AND ANALYTICAL PROCEDURES

Emission rate testing was performed on the No. 11 Power Boiler exhaust in accordance with 40 *CFR* 60 Appendix A. Specifically:

- EPA Method 1 was used for the qualification of the location of sampling ports and for the determination of the number and positions of stack traverse points, as applicable to sample traverses for Method 2.

- EPA Method 2 was employed for the determination of the stack gas velocity and volumetric flow rate during stack sampling using the Type "S" Pitot tube.

- EPA Method 3A was used for the calculation of the density and dry molecular weight of the effluent stack gas as well as to determine the oxygen and carbon dioxide concentrations using a calibrated instrumental analyzer.

- EPA Method 4 was used for the determination of moisture content.

- EPA Method 30B was used for the determination of total vapor phase mercury emissions.

All samples were stored upright in a closed sample box until final laboratory analysis. In order to limit the chain of custody, only essential *AIR* personnel are permitted access to these samples.

5.0 QUALITY ASSURANCE ACTIVITIES

The quality assurance/quality control (QA/QC) measures associated with the sampling and analysis procedures given in the noted EPA reference methodologies, in Subparts A of 40 *CFR* 60 and 40 *CFR 63*, and in the *EPA QA/QC Handbook*, Volume III (EPA 600/R-94/038c) were employed, as applicable. Such measures included, but were not limited to, the procedures detailed below.

5.1 PROBE NOZZLE DIAMETER CHECKS

Probe nozzles were calibrated before field testing by measuring the internal diameter of the nozzle entrance orifice along three different diameters. Each diameter was measured to the nearest 0.001 inch, and all measurements were averaged. The diameters were within the limit of acceptable variation of 0.004".

5.2 PITOT TUBE FACE PLANE ALIGNMENT CHECK

Before field testing, each Type S Pitot tube was examined in order to verify that the face planes of the tube were properly aligned, per Method 2 of 40 *CFR* 60, Appendix A. The external tubing diameter and base-to-face plane distances were measured in order to verify the use of 0.84 as the baseline (isolated) Pitot coefficient. At that time the entire probe assembly (i.e., the sampling probe, nozzle, thermocouple, and Pitot tube) was inspected in order to verify that its components met the interference-free alignment specifications given in EPA Method 2. Because the specifications were met, then the baseline Pitot coefficient was used for the entire probe assembly.

After field testing, the face plane alignment of each Pitot tube was checked. No damage to the tube orifices was noted.

5.3 METERING SYSTEM CALIBRATION

Every three months each dry gas meter (DGM) console is calibrated at five orifice settings according to Method 5 of 40 *CFR* 60, Appendix A. From the calibration data, calculations of the values of Y_m and $\Delta H_@$ are made, and an average of each set of values

is obtained. The limit of total variation of Y_m values is ± 0.02, and the limit for $\Delta H_@$ values is ± 0.20.

After field testing, the calibration of the DGM console was checked by performing three calibration runs at a single intermediate orifice setting that is representative of the range used during field-testing. Each DGM was within the limit of acceptable relative variation from Y_m of 5.0%.

5.4 TEMPERATURE GAUGE CALIBRATION

After field testing, the temperature measuring instruments on each sampling train was calibrated against standardized mercury-in-glass reference thermometers. Each indicated temperature was within the limit of acceptable variation between the absolute reference temperature and the absolute indicated temperature of 1.5%.

5.5 GAS ANALYZER CALIBRATION

5.5.1 CALIBRATION GAS CONCENTRATION VERIFICATION

AIR obtained a certificate from the gas manufacturer and confirmed that the documentation included all information required by the Environmental Protection Agency Traceability Protocol No. 1. AIR confirmed that the manufacturer certification was complete and current and that calibration gases certifications had not expired. This documentation was available on-site for inspection during testing and is presented in Appendix E.

5.5.2 MEASUREMENT SYSTEM PREPARATION

AIR assembled, prepared, and preconditioned each measurement system by following the manufacturer's written instructions for preparing and preconditioning each gas analyzer and, as applicable, the other system components. *AIR* made all necessary adjustments to calibrate the analyzers and the data recorders and to achieve the correct sampling rate.

5.5.3 ANALYZER CALIBRATION ERROR

After sampling system and analyzer assembly, preparation and calibration, AIR conducted a 3-point analyzer calibration error test before the first run. AIR introduced the low-, mid-, and high-level calibration gases sequentially in direct calibration mode. During the test, AIR made no adjustments to the system except to maintain the correct flow rate. AIR recorded the analyzer's response to each calibration gas and calculated the system calibration error. At each calibration gas level (low, mid, and high) the calibration error was within ± 2.0 percent or 0.5 ppm of the calibration span.

5.5.4 INITIAL SYSTEM BIAS AND CALIBRATION ERROR CHECKS

Before sampling began, AIR determined that the high-level calibration gas best approximated the emissions and used it as the upscale gas. AIR introduced the upscale gas at the probe upstream of all sample conditioning components in system calibration mode. The time it took for the measured concentration to increase to a value that is within 95 percent of the certified gas concentration was recorded. AIR continued to observe the gas concentration reading until it reached a final, stable value and recorded the value.

Next, AIR introduced the low-level gas in system calibration mode and recorded the time required for the concentration response to decrease to a value that was within 5.0 percent of the certified low-range gas concentration.

AIR continued to observe the low-level gas reading until it reached a final, stable value and recorded the result. AIR operated the measurement system at the normal sampling rate during all system bias checks and made only the adjustments necessary to achieve proper calibration gas flow rates at the analyzer. From this data, AIR determined the initial system bias was less than 5% of the calibration span for the low- and high- level gases.

5.5.5 MEASUREMENT SYSTEM RESPONSE TIME

AIR calculated the measurement system response time from the data collected during the Initial System Bias Check.

5.6 INSTRUMENT INTERFENCE RESPONSE

AIR obtained instrument vendor data that demonstrates the interference performance specification is not exceeded as defined in EPA Method 7E Section 13.4. Documentation is provided in Appendix D.

5.7 DATA REDUCTION CHECKS

AIR ran an independent check (using a validated computer program) of the calculations with predetermined data before the field test, and the *AIR* Team Leader conducted spot checks on-site to assure that data was being recorded accurately. After the test, *AIR* checked the data input to assure that the raw data had been transferred to the computer accurately.

5.8 EXTERNAL QUALITY ASSURANCE

5.8.1 TEST PROTOCOL EVALUATION

A Site-Specific Test Protocol (SSTP) was submitted to MDEQ in advance of testing, which provided regulatory personnel the opportunity to review and comment upon the test and quality assurance procedures used in conducting this testing.

5.8.2 ON-SITE TEST EVALUATION

A test schedule was submitted with the Site-Specific Test Protocol and MDEQ personnel were notified of all changes in the schedule. No tests were performed earlier than stated in the original schedule. Therefore, regulatory personnel were afforded the opportunity for on-site evaluation of all test procedures.

6.0 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) process is generally a seven-step iterative planning approach to ensure development of sampling designs for data collection activities that support decision making. The seven steps are as follows: (1) defining the problem; (2) stating decisions and alternative actions; (3) identifying inputs into the decision; (4) defining the study boundaries; (5) defining statistical parameters, specifying action levels, and developing action logic; (6) specifying acceptable error limits; and (7) selecting resource-effective sampling and analysis plan to meet the performance criteria. The first five steps are primarily focused on identifying qualitative criteria such as the type of data needed and defining how the data will be used. The sixth step defines quantitative criteria and the seventh step is used to develop a data collection design. In regards to emissions sampling, these steps have already been identified for typical monitoring parameters.

Monitoring methods presented in 40 *CFR* 60 Appendix A indicate the following regarding DQOs: Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods. At a minimum, each method provides the following types of information: summary of method; equipment and supplies; reagents and standards; sample collection, preservation, storage, and transportation; quality control; calibration and standardization; analytical procedures, data analysis and calculations; and alternative procedures. These test methods have been designed and tested according to DQOs for emissions testing and analysis. These test methods have been specified and were followed in accordance with the Site-Specific Test Protocol submitted to MDNRE to ensure that DQOs were met for this project.